Program Research Project

UNITED STATES ROTORCRAFT TECHNOLOGY INVESTMENT: IS THERE A LACK OF A VISION?

BY

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The termination of Comanche and the utilization of a foreign owned company's helicopter platform suggests that the United States and the Department of Defense are not investing in rotorcraft technology and, moreover, that the Army lacks a vision for its rotorcraft fleet. The future of United States rotorcraft technology is dependent upon research and development, as well as a long term national vision for this dynamic technology.

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Topic Approved By
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ABSTRACT

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UNITED STATES ROTORCRAFT TECHNOLOGY INVESTMENT: IS THERE A LACK OF A VISION?

The development of a weapon system begins with an identified need and then flows to the development, production, and fielding of that weapon system. A known philosophy for materiel developers of Army weapon systems is the desire to continually refine and/or update the systems' capabilities. In order to identify and refine the capabilities a plan or a vision for the incorporation of new technologies or concepts should be in place and preferably documented. "Write it down. Written goals have a way of transforming wishes into wants; cant's into cans; dreams into plans; and plans into reality. Don't just think it - ink it!" [1]

The Army is very good at documenting policy, plans and other pertinent information.[2] However, drafting and documenting a long-term strategy for a specific weapon system or family of systems can be a daunting task with so many stake holders involved and the determination of who is the lead. In the case of rotorcraft the Army, as defined by project reliance and by charter, is responsible for rotorcraft Science and Technology (S&T).[3]

The following analysis suggests that there is a vision for the Army's rotary-wing aircraft fleet and that any reduction in investments in technology by the United States (U.S.) is a result of the person's perception and not reality.

Companies are a Key Player

The Industrial College of the Armed Forces (ICAF) conducts an annual review of the aircraft industry. Starting in 2001 the ICAF Industry Study for Aircraft identified U.S. manufactures Bell Helicopter, Boeing, Sikorsky, and foreign manufactures

AgustaWestland and Eurocopter as the top five manufacturers of rotary-wing aircraft.[4] The ICAF studies further note that these top five rotorcraft manufactures provide aircraft to both the military and civil (private industry) sectors. An analysis of the companies' Annual Reports provides an insight into their fiscal capabilities and how relevant research and development investments are to their business.

Bell Helicopter is headquartered in Fort Worth, Texas and is a wholly owned subsidiary of Textron Incorporated. (Textron Incorporated is headquartered in Providence, Rhode Island.) The Bell segment consisting of Bell Helicopter and Textron Systems reported revenues of $3.8B, or 29 percent of Textron's 2007 total revenues, 20 percent of the profit, and has approximately 13,000 employees.[5]

The Textron 2007 Annual Report also reports that the research and development investment has slowly increased from $573M in 2003 to $814M in 2007 and that roughly half of the investment is company funded. Additionally, the report notes that the Bell Helicopter segment is in a long-term upswing in demand from both the military and commercial sectors and that the upswing is primarily due to replacements.[6]

Bell Helicopter is currently developing the Armed Reconnaissance Helicopter (also called ARH-70A) for the U.S. Army and produced the Kiowa Warrior (OH-58). Bell Helicopter is teamed with Boeing to develop the tilt rotor V-22 Osprey aircraft, teamed with AgustaWestland on Marine One (the Presidential helicopter), and consider themselves as the leader in tilt rotor technology.[7]

Boeing is headquartered in Chicago, Illinois. Boeing's 2007 Annual Report notes that the Integrated Defense Systems (IDS) Division, which comprises the military rotorcraft segment, is a $32.08B business with 71,000 employees worldwide. The IDS

Division's revenues constituted approximately 48.3 percent of Boeings' total revenues for 2007. The 2007 Annual Report notes that roughly 84 percent of the IDS Division revenues are from the Department of Defense (DoD) and that the Research, Development, Test and Evaluation (RDTE) account is "flat" at approximately $830M.[8] In addition, the 2007 Annual Report states that United States DoD spending makes up roughly half of the worldwide defense spending and that the IDS Division is clearly interrelated to the United States DoD Budget.[9]

The Apache Longbow (also called AH-64D) and the Chinook (CH/MH-47) are the rotary-wing aircraft Boeing produces for the U.S. Army.

Sikorsky Aircraft Corporation is a business unit of the United Technologies Company and is headquartered in Stratford Connecticut. (United Technologies Company is headquartered in Hartford, Connecticut.) The 2007 Annual Report for United Technologies Company reports revenues of $54.759B of which $4.798B is from the Sikorsky segment. The "company" funded investment for research and development was $1.678B and is consistent with prior years at approximately three percent of the revenues.[10]

The Black Hawk (also called UH-60) is the rotary-wing aircraft Sikorsky produces for the U.S. Army.

AgustaWestland is a subsidiary of Finmeccanica and is headquartered in Samarate, Italy. (Finmeccanica is headquartered in Rome, Italy) The 2007 Annual Report for Finmeccanica reports revenues of 13.429B Euros ($21.376B[11]) and a workforce of 60,748 of which 9,556 belong to AgustaWestland. The research and development segment represented "roughly 14 percent of 2007 revenues with the bulk

(96 percent) going to the Aerospace and Defense segments".[12] The Helicopters Group reported revenues of 2.98B Euros ($4.74B), a research and development expenditure of 18 percent of the total research and development budget, and that AgustaWestland in concert with Boeing Integrated Defense Systems is preparing a bid that will commit the two manufacturers to supply CH-47F helicopters to replace the current Chinook helicopter fleet used by the Italian Army.[13]

AgustaWestland does not manufacture any rotorcraft for the U.S. Army, however, "The US101 is the EH101 version offered on the American market in collaboration with Lockheed Martin and Bell Helicopters, 23 of which have already been selected as replacements for the presidential transportation service in the United States."[14] In addition, Finmeccanica's web page states that "Finmeccanica is, together with AgustaWestland and its subsidiaries, a leader in the extremely restricted circle of systems designers in the world helicopter industry with EADS (Eurocopter) and United Technologies (Sikorsky)."[15]

Eurocopter is a wholly owned subsidiary of the European Aeronautic, Defence and Space (EADS) Company and is headquartered in Marignane, France. The EADS Company is headquartered in Schiphol-Rijk, the Netherlands and employs approximately 116,800 people of which approximately 14,000 belong to the Eurocopter Group. The 2007 Annual Report for EADS reports revenues of 39.123B Euros ($62.276B), of which 4.172B Euros ($6.641B) are for Eurocopter; and the report states that the research and development investment is "flat" and that only a small increase was for the Airbus platform.[16] The 2007 Annual Reports states that EADS "achieved 56 percent of its revenues outside Europe due to strong contributions from North America

(20 percent), Asia-Pacific (23 percent) and other regions (13 percent)" and that revenues are basically constant, but they do need to cope with the long term low value of the US dollar.[17]

American Eurocopter (a subsidiary of EADS North America) is the United States subsidiary of EADS which manufactures the Lakota (UH-72) for the U.S. Army. In addition, in March 2008 Northrop Grumman in partnership with Eurocopter won the contract to design and build refueling tankers for the U.S. Air Force.[18]

Given the summation of these five companies, clearly Boeing relies heavily on their Integrated Defense Systems Division revenues and subsequently the DoD for business and that EADS relies heavily on non-European entities for its revenues. Relative to research and development, investments have been "flat" for the military/rotorcraft platforms. None of the company annual reports or other literature search documents distinguished between RDTE investments made by U.S. verses foreign governments for rotorcraft S&T. From an overall industry perspective these five manufacturers are fiscally sound; globally interconnected via corporative working agreements or consortiums; and provide rotorcraft for all U.S. military services, various foreign military services and the general private sectors.

Financial and Budgetary Issues are Key Factors Too

The Planning, Programming, Budgeting, and Execution System (PPBES) and the Program Objective Memorandum (POM) reflect the budgetary requirements for the DoD and subsequently the Army. The POM is developed utilizing a bottoms up review of program requirements. Army funding like DoD funding is appropriated in "colors of money" with RDTE and Procurement as the primary types of appropriations utilized for

the development and production of weapons systems. The RDTE appropriation is further subdivided into seven levels. These seven levels of funding cover funding for the most basic research (concepts that may or may not have a military application) to funding of the research and development of materials and concepts that can be applied to currently fielded systems. The Procurement appropriations distinguish between the different commodities (i.e. aircraft, missile, ammunition, etc.).[19]

The POM is comprised of the Descriptive Summaries or R-Forms and P-Forms.[20] An analysis of data collected from the R-Forms presented at and as part of the 2009 President's budget for the Army shows that RDTE 6.1, Basic Research - Providing Fundamental Knowledge is not specifically tied to any type of commodity. However, the RDTE 6.1 R-Forms do distinguish that certain Army In-house Independent Research Laboratories are budgeted funds consistent with the objectives of the Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, the Army Science and Technology Master Plan and the Department of Defense Basic Research Plan. As part of this, the Program Element (PE) line (see Appendix) for the U.S. Army Aviation and Missile Research Development and Engineering Center (AMRDEC) for aviation reflects a small increase of basic research funding from fiscal year (FY) 2007 to 2009. The RDTE 6.1 R-Forms for FYs 2010 to 2013 only represent the In-House Laboratories as a whole and that PE line reflects a constant investment consistent with FYs 2007 to 2009.[21]

Under RDTE 6.2, Applied Research - Technology Transition to Military Needs, PE line 0602211A, Aviation Technology has a steady stream of funding of around $40M planned for FY 2009 to 2013. All other PE lines were FY 2008 Congressional add-ons

(i.e. earmarks) worth $6.4M. Some specific examples of Applied Research activities include propulsion technologies to improve fuel consumption; horsepower to weight ratios; operation and support cost savings; and aircraft survivability component technologies to include adaptive infrared signature suppression of engine and airframe thermal sources, visual signature control, and acoustic signature attenuation.[22]

Similarly PE line 0603003A, Aviation Advance Technology under RDTE 6.3, Advance Technology Development - Transition to Weapon Development and Integration, has a high of $98.899M in FY 2008, drops to $57.277M in FY 2009 but then increases incrementally from $69.597M in FY 2010 to $89.521M in FY 2013. Also noted is that for FY 2008 the RDTE 6.3 lines had $50M in Congressional add-ons related to aviation.[23]

An important issue to note here is that the Army, as the lead service in Rotorcraft S&T (and subsequently the AMRDEC), is responsible for Rotorcraft S&T and thus responsible for some of the specific PE lines on the R-Forms for RDTE 6.1, 6.2, and 6.3. Further, as the AMRDEC develops these R-Forms for RDTE 6.1, 6.2, and 6.3, they obtain input/feedback from the rotorcraft project offices and other stake holders.[24]

Under RDTE 6.5, Weapon System Development and Demonstration, PE line 0604201A-C97, Aircraft Avionics has a fluctuating stream of funding with a high of $77.630M in FY 2010 to a low of $12.361M in FY 2013. Also noted in this 6.5 level of RDTE is PE line 0604220A-53H, Armed, Deployable OH-58D, Armed Reconnaissance Helicopter. The RDTE funding ceases in FY 2011 and the corresponding Procurement PE Line A04203 in FY 2008 to 2013 increases.[25]

Under RDTE 6.7, Operational System Development, PE line 0203744A, Aircraft Modifications/Product Improvement Programs, has several planned activities that represent fluctuating funding. Most noted are Sub-line 028, Aerial Common Sensor which has a significant increase in funding starting in FY 2009 and Sub-line 430, Improved Cargo Helicopter which has a decreasing stream of RDTE funding until 2012. However and as expected corresponding Procurement PE lines A05008, CH-47 Cargo Helicopter New Build (Including Adv Proc); and AA0252, CH-47 Cargo Helicopter (MYP) (Including Adv Proc and Initial Spares) reflect substantial amounts for production and fielding activities.[26] Sub-line 504, Black Hawk Recapitalization/Modernization drops significantly in FY 2009 but then levels off through FY 2013, and Sub-line, D17, Apache Block III, which has solid planned funding at around $195.0M through FY 2009 but then, reduces steadily to $53.451M in FY 2013.

Finally RDTE 6.4, Weapon System Demonstration and Validation and RDTE 6.6 RDT&E Management and Support basically reflect a constant stream of funding. The only exception is RDTE 6.4 PE line 0603827A-S51, Soldier Systems, in which Aircrew Integrated Systems development and prototyping basically ends in FY 2008 and the corresponding procurement PE line continues.[27]

From the aforementioned POM lines, Army Aviation has planned funding for research and development in fundamental research (RDTE 6.1 and 6.2) and transition to aircraft platforms (RDTE 6.3), however most RDTE funding for Army aviation is at the 6.7 level which is for the incorporation of materials and concepts on currently fielded systems. The amount of RDTE 6.7 reflects a concerted effort to modernize/recapitalize/reset existing rotorcraft versus developing new designs.

The National Defense Budget Estimate for FY 2009 presents to the reader a current snapshot of the DoD budget and an historical tabulation of selected budgetary activities. Analysis of the raw numbers of the historical activity of Army Outlays for RDTE in terms of percent Real Growth (utilizing constant dollars) from FY 1948 to POM year FY 2013 shows a randomness of growth in both the positive and negative directions.[28] Clearly the positive growth of Army RDTE correlates to the United States' involvement in the Korean Conflict, the Vietnam War, and the current Global War on Terrorism (GWOT) activities in Afghanistan and Iraq. The negative growth also correlates to the end of the aforementioned events with the exception of the current GWOT operations. When percent Real Growth is graphed per FY the general trend is positive, that is, there are more points above the zero line than below (see Figure 1. on next page). When RDTE Outlays are graphed at constant dollars versus FY (see Figure 2. on next page) there is a steady increase between 1948 and 1965, a period of relative constant investment from 1965 till the mid 1970s followed by minor dip till 1980. From 1980 there is a steady growth till the early 1990s followed by a sharp decrease till 2001 and then a sharp increase till FY2008. The "planning" or out-years of the POM reflect a sharp decrease from FY 2009 to 2013.[29]

Current Documentation and Their Key Role

A literature search was conducted and no single document was identified as the "vision" for Army Rotorcraft. However, several documents of interest were identified and collectively they have significance.

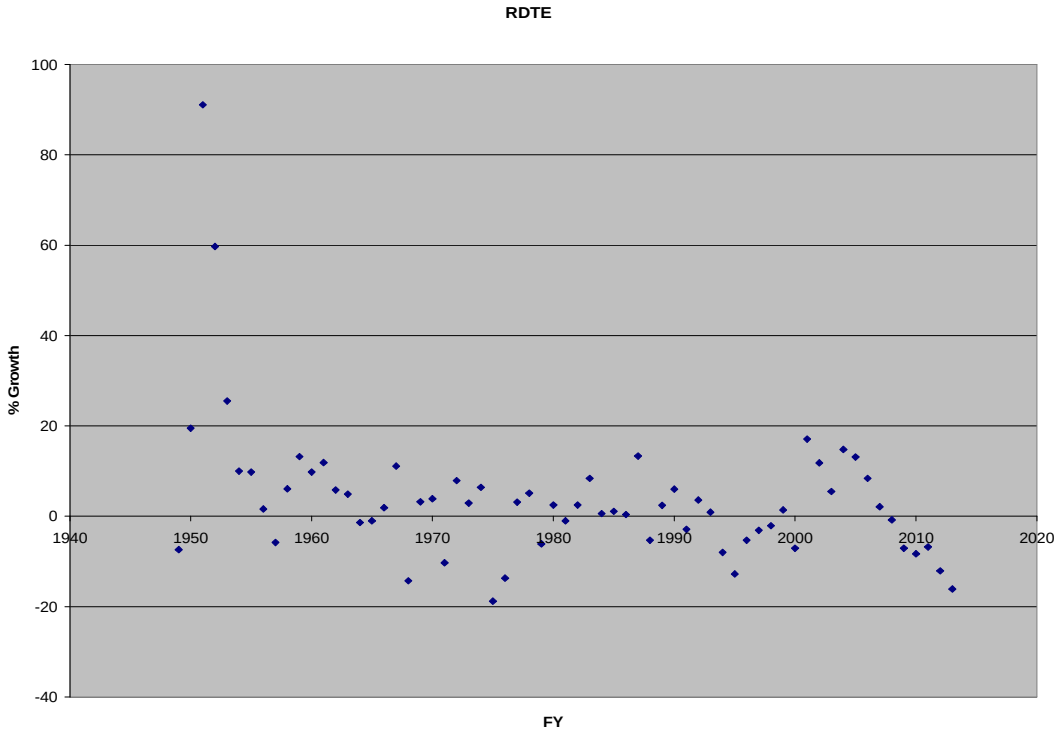

Figure 1. Percent Growth per Fiscal Year

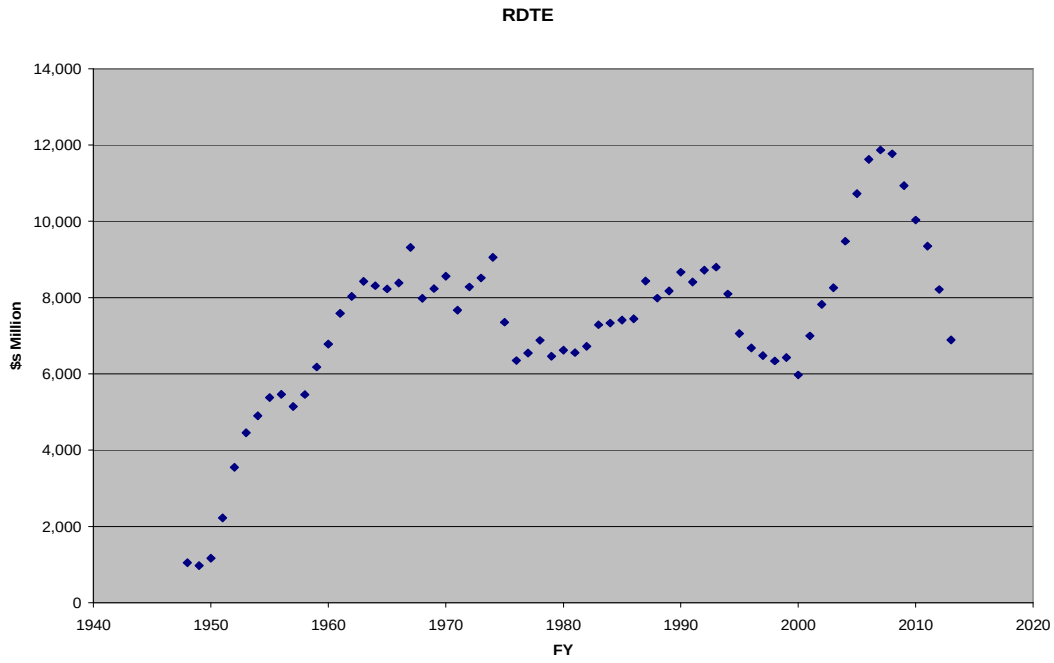

Figure 2. Constant Dollar per Fiscal Year

The first is the presentation chart describing the Army Aviation Modernization Plan.[30] This single chart represents the plan on how to keep the funding planned for the Comanche program within Army Aviation. The Army, on 27 February 2004 terminated the Comanche program with the intent to keep the funding in Army Aviation.[31] The RDTE POM lines, especially the 6.7 funds, reflect this modernization plan.

The 2007 Army Science and Technology Master Plan (ASTMP) is considered the single source to describe the Army's science and technology strategy, major technology objectives, research goals, and the roles and relationships between the science and technology community and the users. Whereas the Quadrennial Defense Review Report serves as the "Roadmap to change" and the Army Modernization Plan describes the decisions of improving current capabilities or developing new ones, the ASTMP "summarizes" the major science and technology developmental efforts.[32]

The 2007 ASTMP specifically identifies the need for maturing technologies and Advance Technology Objectives for aircraft survivability, third-generation infrared technologies for intelligence and surveillance and manufacturing technologies to improve the cost effectiveness of aircraft production and maintenance.[33] The 2007 ASTMP describes the U.S. Army Training and Doctrine Command's role in science and technology as providing the "vision of the possible" and the means to develop the implementation, testing, and validation of the concepts, capabilities and ideas.[34] From the globalization aspect, the Army Global Science and Technology Watch vision is to capitalize on foreign nation investments of science and technology for Army use through co-production or outright acquisition of the technologies.[35]

Additionally, the 2007 ASTMP states that the Army Modernization Plan lays out two components of the modernization strategy: 1) to maintain and/or enhance the current war fighter capabilities, and 2) to develop new and/or improve existing technologies for the future force.[36] The 2007 ASTMP and the RDTE R-Forms correlate with each other.

The 2007 Army Modernization Plan serves as the vehicle that describes the efforts to modernize and transform the Army in concert with the Army Posture Statement and Army Campaign Plan; and that the cornerstone to modernization of the Army is the development and fielding of the Future Combat System.[37] The 2007 Army Modernization Plan identifies key technology investments. The technologies associated with aviation are investments in initiatives such as "Embedded prognostics and diagnostics to achieve capabilities for prediction-based/anticipatory logistics" and "New materials and coatings for enhanced reliability and maintainability of various component parts and systems".[38] Specific aviation modernization items described are generally in sync with the aforementioned Army Aviation Modernization Plan presentation chart on the modernization of the Army rotary-wing fleet through recapitalization, reset, and modifications.[39] The exception is the Armed Reconnaissance Helicopter, the Lakota Light Utility Helicopter, and the Unmanned Aerial Systems. These three systems are currently being developed and when produced will be new to the Army aviation inventory. Further, the Army Modernization Plan provides an overview of the key Army Aviation systems and their current status.

The 2006 Quadrennial Defense Review (QDR) Report discusses where the DoD is and where it needs to go to fulfill the department's responsibility to the American

public. Written at the strategic level, the QDR Report only supports the vision of Army rotorcraft in global terms. The QDR Report confirms the Army Aviation Modernization Plan presentation chart in that "In 2004, the Army terminated the Comanche helicopter program and reallocated funds to reinvigorate its aviation capabilities, including unmanned aerial vehicles."[40]

The Congressional Budget Office (CBO) Report titled "Modernizing the Army's Rotary-Wing Aviation Fleet" compares the Army Aviation Modernization Plan presentation chart (as described above) with four other cost reduction alternatives. The CBO concluded that "Short of significantly cutting the aviation force structure or accepting further aging of the fleet, there is limited potential to reduce spending on the Army's helicopter modernization over the next 5 to 10 years".[41]

The Aviation S&T Strategic Plan (ASSP) 2005 Draft describes the goals and a vision for Joint Services Vertical Take Off and Land Rotorcraft and Army Aerial Systems. A complementary presentation of the same name provides a summary of the plan.[42] The ASSP describes a vision and a general need for a business process and associated infrastructure to develop and transform technologies for:

1. Interoperable, Joint, Interagency, Multi-national (JIM)
2. Reduced operation and support footprint consistent with employment echelon
3. Operations 24/7 in near all-weather and complex terrain
4. Responsive global deployment and worldwide land & sea based employment
5. Full Spectrum, distributed survivability and lethality
6. Synergistic teaming of manned and unmanned systems
7. Vertical maneuver of mounted forces

8. Platform attributes consistent with joint air/ground operations
9. All Short/Vertical Take-Off and Landing Marine Corps Aviation [43]

One aspect of the 2005 draft of the ASSP that has not been addressed in other documents is the Technology Assessment and Transition Management (TATM) process. The TATM process not only addresses how to assess the maturity of technology but how to address the ability and readiness for integration while working within the fiscal constraints (i.e. prioritization).[44]

The Industrial College of the Armed Forces annual assessments of the Aircraft Industry provide a broad summary of the aircraft industry and as noted list U.S. manufactures Bell Helicopter, Boeing, Sikorsky, and foreign manufactures AgustaWestland and Eurocopter as the top five manufacturers of rotary-wing aircraft. Further, the 2007 Spring Report states that "While the civil sector remains a robust market, there are few new rotary-wing aircraft being developed for the military market".[45] The report also notes that stagnation of the military market (few new designs and low production quantities) could result in the loss of skilled designers, loss of second and third tier suppliers, specialty metals and funding.[46]

The Program Executive Office (PEO) for Aviation on 31 January 2008 sponsored a Home-on-Home at Redstone Arsenal, Alabama, in which representatives from PEO Aviation and PEO Aviation Project Offices presented to the U.S. Army AMRDEC a cadre of presentations on the aviation technology gaps between what is currently being used and what is required/desired by the combat developers.[47] The first key take-home from the Home-on-Home presentations is the ten aviation capability gaps identified by

the U.S. Army Aviation War Fighting Center at Fort Rucker, Alabama, and one could conclude that closing these gaps would constitute a vision. The gaps are:

1. Improved operational availability, mission reliability, and logistical support
2. Safety of flight in adverse environmental conditions
3. Aircraft and pilot survivability
4. Joint communications interoperability and jamming/countermeasures
5. Need more power, speed and control
6. Ineffective Aviation reconnaissance, surveillance, and target acquisition
7. Too much going on in the cockpit
8. Need better weapons
9. More efficient Army Air Traffic Services
10. Incompatibility with the Future Combat System Heavy Lift requirements [48]

The second key take-home is "The Roadmap" chart which presents the rotorcraft mission for the near term, the POM years, the Extended Planning Period years, and FY 2025 and beyond.[49]

One final document warranting consideration is the 2007 DoD Research and Engineering Strategic Plan. The plan describes its purpose as the collective guide to DoD investments and management of priorities.[50] The vision and mission of DoD research and engineering is to provide the "investment to provide superior systems with the capabilities to defeat any adversary on any battlefield".[51] For the Army the plan states that the vision is to "pursue technologies that will enable the future force, while simultaneously seizing opportunities to enhance the current force".[52]

What Others are Thinking

When no specific document identifying a vision for Army rotorcraft was identified the selected alternative means to determine the vision and/or status of the Army rotorcraft sector was to conduct a survey and/or to interview the interested parties. The intent of the survey and/or interviews was to obtain a perspective of where the rotorcraft sector RDTE investment currently stands and where it is heading from the point of view of the companies, people (Government and Industry), and professional organizations that have an interest in rotorcraft.[53]

The results of the survey provided little benefit to the research as the only participants were two associations. The only other response was from one company and they noted that they did not have the time to participate in an academic research project.[54] However, it was through a daisy chain of information sharing from the survey results received and personal contacts that the following opinions and data-sets were identified.

The "Dip" Concept. In a paper to the American Helicopter Society Specialist's Conference on Aeromechanics in January of 2008, University of Maryland professor J. Gordon Leishman refers to a learning curve that depicts one's opinion of technical competence (and improved understanding) against time and effort and that after a period of "qualitative understanding and postdictive capability" and before working harder at the problem is a period of "comfort zone" and a "dip".[55] Professor Leishman further suggests that in the world of aeromechanics the dip is not just technologically related but a more complex set of dynamics that include education, the ability to conduct experiments, leadership, planning, goal setting, culture, and funding levels.[56] Though the reasons for the "dip" are complex, crossing over the dip is dependant upon

two basic issues; technological and effective leadership, and that funding plays a key role to both.

Rotary-Wing Revitalization Project. In an unpublished report from the Aerospace Industries Association a Study Group, that included representatives from Bell Helicopter, Boeing, and Sikorsky, looked at the effects of decisions made by the United States and its effect on the rotorcraft industrial base. The Study Group findings reiterate professor Leishman's notion that rotorcraft aeromechanics is unique and that it requires professionally trained experienced designers and that that pool of individuals is shrinking. The report notes that collectively the American rotorcraft industry has "invested substantial internal research and development funding to keep the technical staff operating while hoping for new programs starts".[57]

The report further notes that the military market for rotorcraft is twice that of the commercial sector and those military requirements are what drive innovations.[58] However, the Army being the lead service in rotorcraft technology actually invests less in RDTE than the Navy and the Air Force for hardware development and that less than five percent of the Army RDTE budget is dedicated towards the rotorcraft fleet.[59] The report does suggest that the decline in RDTE budgets is somewhat attributed to meeting the current GWOT operational demands.[60]

In a confirmation of these findings the April 2008 issue of Rotor and Wing Magazine concludes that "the Pentagon and its agencies form the engine of rotorcraft R&D in the United States" and that the commercial sector will not be able to make up the difference.[61] In a second report from the Aerospace Industries Association a correlation between the current GWOT operations and investment is also drawn in that

"Funding for investment is gradually being squeezed from the baseline defense budget as military personnel and operations and maintenance costs take an increasing share of defense resources".[62] Additionally, a 2004 DoD report titled The Vertical Lift Industrial Base: Outlook 2004-2014 states that "today's pressing operational needs and the Department's failure to fund new technology has discouraged innovation. Industry has-understandably-focused on near-term customer needs from the remanufacture of legacy platforms and aftermarket support".[63]

The Congressional Rotorcraft Caucus. The Congressional Rotorcraft Caucus consisting of Pennsylvania Democrat Joe Sestak and Texas Republican Kay Granger drafted a letter on 18 January 2008 to Secretary of Defense Robert Gates and Joint Chiefs of Staff Chairman Admiral Michael Mullen (U.S. Navy). The letter requested that DoD provide the Caucus the "results of a Capabilities-Based Assessment that outlines a joint approach to the future development of vertical lift aircraft for all military services".[64] To be included in the submittal is the development of common service requirements, a technology roadmap, a detailed science and technology investment and implementation plan, and a plan to establish a Joint Vertical Lift Aircraft Office.[65]

A Personal Perspective. In an informal conversation during the 31 January 2008 Home-on-Home, a representative from the U.S. Army Aviation War Fighting Center at Fort Rucker, Alabama commented that the closest document to an Army Vision for Rotary-Wing Aircraft is the March 2007 Congressional testimony of Brigadier General Stephen D. Mundt to the Tactical Air and Land Forces Subcommittee, Committee on the Armed Force, U.S. House of Representatives.[66]

Brigadier General Stephen D. Mundt's statement to Congress notes that the Army remains committed to the Army Aviation Modernization Plan (beginning with the termination of the Comanche Program) and that the Army Aviation S&T Program (based on the Army Aviation Transformation and Aviation Modernization Strategy) will focus on two key areas: 1) developing and maturing systems and components that support survivability, operational readiness, maneuverability, platform lift, and endurance; and 2) the conduct of demonstrations of technologies in combat situations.[67] [68]

I There a Vision or Not?

Whether the lack of a future vision for Army Aviation resulted in the decline of rotorcraft technology investments by the United States as compared with foreign governments and industries depends on your perspective. In his book "The Tipping Point", author Malcolm Gladwell references the "Law of the Few" - in order for a concept to "take off" it needs three things: 1) Connectors, 2) Mavens (experts), and 3) Salesmen.[69]

In an application of Mr. Gladwell's "Law of the Few" to the Army rotorcraft scenario the Connectors are the individuals who also serve as Mavens and belong to the same organizations (e.g. the Army Aviation Association of America and the Association of the United States Army) as the Salesmen. The Mavens are the Government entities and individuals within the Army and the DoD who develop the POM (with the respective R-Forms), the Army Aviation Modernization Plan presentation chart, the ASTMP, the 2005 draft of ASSP, and other strategic plans. The Salesmen are the manufacturers of rotorcraft and the industry associations they subscribe to (e.g. American Helicopter Society and the Aerospace Industries Association). Duly noted is

that the Salesmen have a primary function to increase their business' profits and to influence senior leaders to make financial decisions that favor their industry/company.

Mr. Gladwell further noted that a "Band-Aid" solution is actually the best kind of solution because it involves solving a problem with the minimum amount of effort, time and cost".[70] The Army Aviation Modernization Plan presentation chart is one "Band-Aid" solution to reverse the apparent decline in rotorcraft technology investments. Additionally, the Army and by association the DoD rotorcraft sector has the POM (with the respective R-Forms) and the ASTMP as its vision along with planned funding.

From the perspective of RDTE investments made by foreign governments, no recent data was discovered concerning their rotorcraft technology investments and therefore no comparison can be made with the United States.[71]

Conclusion

Having a written vision is important to transforming an aspiration to reality. In the Government and commercial sectors, having the monetary issues planned and available is just as important. The lack of a vision does not necessarily mean that the funding associated with it will decline. On the reverse, having a vision will not necessarily result in an increase of monetary and other resources.

The conclusion reached based on this research is that there basically is a vision for the future of Army rotorcraft but that vision is not specifically documented in one document. The Army rotorcraft vision is primarily reflected in the budgetary R-Forms. Additionally, the ASTMP, the U.S. Army Aviation War Fighting Center Gap identification presentation, the Army Aviation Modernization Plan presentation chart, and the 2005

draft of ASSP support the R-Form vision. Collectively all these documents constitute a strategy and "The idea of Persistent Strategy fits regardless of the strategy".[72]

Not to be discounted is the possibility that was implied within these findings is that the apparent decline in the investment of RDTE in rotorcraft is partially tied to the current GWOT operational demands and the increased cost of conducting research and development rather than not having a vision. Clearly, the Army rotorcraft community (and by charter the DoD rotorcraft community) would be well served to update and publish the ASSP and to continue with regularly scheduled Home-on-Homes'. Highlighted within the ASSP is the implementation of the TATM process and the necessity to prioritize requirements within the fiscal means. In concert with the ASSP is the development of the aviation R-Forms which needs to utilize the TATM process and prioritization method. All the pieces are there to think and ink a roadmap - a vision.

Endnotes

[1] The author first used this quote in the U.S. Army Aviation and Missile Command Value Engineering (VE) Office, VE View Newsletter, To Our Readers section, Fiscal Year 2007, 1st Quarter. The author of the quote is unknown. This quote and other famous quotes related to goal setting are available from <http://www.about-personal-growth.com/goal-quotes.html>; Internet; accessed 22 March 2008.

[2] One can easily make this conclusion with the existence of Army Regulations, Department of the Army Forms, Standing Operating Procedures, and other documents. In the materiel development arena there are documents such as Acquisition Strategies and Test and Evaluation Master Plans that document pertinent materiel development information.

[3] U.S. Department of the Army, Aviation and Missile Research Development and Engineering Center, Aviation S&T Strategic Plan (Draft) (Redstone Arsenal, AL: Aviation and Missile Research Development and Engineering Center, 25 May 2005), vi. Also, United States Marine Corps, Marine Corps Science and Technology Strategic Plan, (Washington, DC: U.S. Marine Corps, August 2007) C-2. The specific wording in the Marine Corps document is "AMRDEC. U.S. Army Research, Development and Engineering Command: responsible, by charter, for Rotorcraft S&T. This is a key relationship as Rotorcraft S&T investment has been minimal for over a decade". The plan can be found at <http://www.onr.navy.mil/sci_tech/30/docs/ST_Strategic_Plan_Signed_07.pdf>; Internet; accessed 16 April 2008.

[4] ICAF Industry Studies; available from <http://www.ndu.edu/icaf/industry/reports.htm>; Internet; accessed 25 April 2008.

[5] Textron Web Page, available from <http://www.textron.com/textron_businesses/bell/index.jsp>; Internet; accessed 22 March 2008.

[6] Textron Annual Report for 2007, available from <http://www.textron.com/ir/annual_report/index.jsp>; Internet; accessed 22 March 2008.

[7] Ibid.

[8] Boeing Annual Report for 2007, available from <http://www.boeing.com/companyoffices/financial/financial.html>; Internet; accessed 25 April 2008 and Boeing Web Site, available from <http://boeing.com/ids/ids-back/index.html>; Internet; accessed 25 April 2008.

[9] Ibid.

[10] United Technologies Annual Report for 2007, available from <http://investors.utc.com/annuals.cfm>; Internet; accessed 22 March 2008, and United Technologies Web Site, available from <http://utc.com/profile/facts/index.htm>; Internet; accessed 22 March 2008. Noted is that the United Technologies Company owns Carrier (manufacturer of Heating and Cooling Systems), Otis "the world's largest manufacturer, installer, and servicer of elevators, escalators, moving walkways and other horizontal transportation systems", and other commercial product suppliers.

[11] Conversion rate of 1 Euro = $1.5918 as of 16 April 2008. All subsequent conversions were conducted utilizing the same rate. Conversion rate was derived by conducting a Google search on "Euro to Dollar Conversion". <http://google.com>; Internet; access 16 April 2008.

[12] Finmeccanica Annual Report for 2007, available from <http://www.finmeccanica.com/EN/Common/files/Holding/Corporate/Investor_relations/Bilanci_e_prospetti/2007/BILANCIO_CONSOLIDATO__2007_ENG_rev.pdf>; Internet; accessed 22 March 2008.

[13] Ibid.

[14] Ibid. EH101 is the designation/name of the medium-lift helicopter manufactured by AgustaWestland for the European market. US101 is the designation/name given to the American version and available in the United States. US101 is also known as the VH-71, Marine One, or the Presidential Helicopter.

[15] Ibid.

[16] EADS Annual Report for 2007, available at <http://www.eads.net/1024/en/investor/Reports/Current_Publications.html >; Internet; assessed 22 March 2008, and EADS Web Site, available from <http://www.eads.eu/1024/en/businet/eurocopter/eurocopter.html>; Internet; accessed 22 March 2008.

[17] Ibid.

[18] Northrop Grumman Press Release dated 29 February 2008, available from <http://www.irconnect.com/noc/press/index2.html>; Internet; accessed 19 April 2008.

[19] A thorough description of the levels of RDTE and how the PPBES works can be found in "How the Army Runs" available from <http://www.carlisle.army.mil/usawc/dclm/htar2007.htm>; 256)

[20] In a telephone conversation on 15 January 2008 with Ms. Nancy Moriarty, U.S. Army Aviation and Missile Research, Development and Engineering Center Budget Analyst, the author was informed that the POM is "basically" the President's Budget and the DoD portion of the President's Budget is the collection of the Descriptive Summaries (also known as R-Forms and P-Forms). For the purposes of this research Army budget data, specifically the "Research and Development Descriptive Summaries (RDTE R-Forms)" were downloaded from http://www.asafm.army.mil/budget/fybm/fybm.asp on 08 February 2008. The Program Element lines associated with aviation were assembled into a spreadsheet for analysis. A copy of the spreadsheet is provided in the Appendix. Ms. Moriarty also instructed the author on how to interpret the R-Forms, and how to distinguish between Army budgeted lines and Congressional add-ons.

[21] U.S. Department of Army, Assistant Secretary of the Army (Financial Management and Comptroller), Supporting Data FY 2009 Budget Estimate – February 2008, Descriptive Summaries of the Research, Development, Test, and Evaluation Army Appropriation Budget Activities, (Washington, DC: U.S. Department of Army, February 2008)

[22] R-Forms, Volume 1, page 122.

[23] Any Congressional add-ons for POM years 2009-2013 will be determined during the corresponding FY budgetary process.

[24] In a second telephone conversation on 11 April 2008 with Ms. Nancy Moriarty, U.S. Army Aviation and Missile Research, Development and Engineering Center Budget Analyst, the author clarified issues on who provides input to the R-Forms and also noted that there appears to be a steady state of RDTE funding for 6.1, 6.2, and 6.3 but the cost of doing research has become more expensive. The conformation of a steady state investment for Aviation S&T in RDTE 6.1, 6.2, and 6.3 is additionally reflected in an AMRDEC presentation chart titled Army Aviation S&T Funding. U.S. Army Aviation and Missile Research Development and Engineering Center, "Army Aviation S&T Funding, (Constant FY08 $M)", briefing slide, U.S. Army Aviation and Missile Research Development and Engineering Center, 7 May 2008.

[25] R-Forms, Volume 2, page 281.

[26] R-Forms, Volume 3, page 200.

[27] R-Forms, Volume 2, page 246.

[28] U.S. Department of Defense, Office of the Under Secretary of Defense (Comptroller), National Defense Budget Estimate for FY 2009, (Washington, DC: U.S. Department of Defense, 4 February 2008), 184. This document is commonly referred to as the "Greenbook" and is

available from <http://www.defenselink.mil/comptroller/defbudget/fy2009/fy2009_greenbook.pdf >. Outlays were used versus Budget Authority or Total Obligation Authority as Outlays are (with the exception of FY 2008-2013) funding spent versus planned or programmed.

[29] The level of detail in the "Greenbook" does not present details at the commodity levels (e.g. Missile, Aviation, etc.). However, a 2004 report titled The Vertical Lift Industrial Base: Outlook 2004-2014 references a DoD trend in vertical lift science and technology that, as a whole, follows the same pattern as presented in Figure 2. See U.S. Department of Defense, Office of the Under Secretary of Defense (Industrial Policy), The Vertical Lift Industrial Base: Outlook 2004-2014, (Washington, DC: U.S. Department of Defense, July 2004), 9. Therefore, it is reasonable to assume that investments in rotorcraft RDTE is comparable to the DoD RDTE trend. The Industrial Base report also notes that the unmanned sector is expected to take a large portion of the RDTE investment.

[30] For this research project the referenced chart was taken from a Town Hall presentation to the workforce located at Redstone Arsenal, Alabama on 18 October 2007. Mr. Claude Bolton, then Assistant Secretary of the Army (Acquisition, Logistics and Technology) and Army Acquisition Executive provided the briefing. The author has seen this particular chart at several other presentations attended. Being briefed by Mr. Bolton at a major command Town Hall reflects its significance to the vision of Army Rotorcraft. This Army Aviation Modernization Plan presentation chart is sometimes referred to as the Army Aviation Modernization Strategy.

[31] Army Acquisition Executive Claude M. Bolton, Subject: Comanche Program Guidance, memorandum for Program Executive Officer, Aviation Systems, Washington, DC, 27 February 04 and The Under Secretary of Defense Michael W. Wynne, Subject: Comanche Program Guidance, reply memorandum for Army Acquisition Executive, Washington, D.C., 27 February 04. Additionally, the Quadrennial Defense Review Report for 2006 stated "In 2004, the Army terminated the Comanche helicopter program and reallocated funds to reinvigorate its aviation capabilities, including unmanned aerial vehicles".

[32] U.S. Department of the Army, Office of the Deputy Assistant Secretary of the Army for Research and Technology, Army Science and Technology Master Plan 2007, (Washington, DC: U.S. Department of the Army, 2007) I-2. Plan can be found at <https://www.us.army.mil/suite/doc/7166787>; Army Knowledge Online access is required.

[33] Ibid., II-4, II-10, and II-51.

[34] Ibid., A-1.

[35] Ibid., B-2.

[36] Ibid., I-3.

[37] U.S. Department of the Army, Office of the Deputy Chief of Staff, G-8, 2007 Army Modernization Plan, (Washington, DC: U.S. Department of the Army, 2007), 2, 7.

[38] Ibid., 16.

[39] Recapitalization is the rebuild, repair, and/or selected upgrade of a currently fielded system. Rebuild brings the system to zero hour/miles or "like new" condition. Selected

upgrades rebuild the systems with upgrades in capabilities and/or technology. These particular definitions were adapted from the 2007 Army Modernization Plan pages 13 and 14. Reset generally refers to restoration of readiness of equipment that has been destroyed, damaged, stressed, or worn out due to combat operations and bringing that system back to pre-deployment condition. Modifications generally refer to adding new capabilities and technology across the fleet versus selected aircraft. Recapitalization, rebuild, reset, upgrade, and repair are all methods that are "perceived" to cost less than acquiring a totally new system. (2007 Army Modernization Plan page 13)

[40] U.S. Department of Defense, Quadrennial Defense Review (QDR) Report, (Washington, DC: U.S. Department of Defense, 2006), 42.

[41] Congressional Budget Office, Modernizing the Army's Rotary-Wing Aviation Fleet, (Washington, DC: U.S. Congressional Budget Office, November 2007), IX.

[42] Aviation S&T Strategic Plan (ASSP) 2005; available from <http://www.dtic.mil/ndia/2005science/chase.ppt>; Internet; accessed 22 April 2008.

[43] U.S. Department of the Army, Aviation and Missile Research Development and Engineering Center, Aviation S&T Strategic Plan (Draft) (Redstone Arsenal, AL: Aviation and Missile Research Development and Engineering Center, 25 May 2005), 2.

[44] Ibid.

[45] Industrial College of the Armed Forces, Spring 2007 Industry Study for Aviation, available from <http://www.ndu.edu/icaf/industry/reports/2007/pdf/2007_AIRCRAFT.pdf>; Internet; accessed 25 April 2008. A complete set of Industry Studies can be found on the Industrial College of the Armed Forces Web Site at <http://www.ndu.edu/icaf/industry/reports.htm >.

[46] Ibid.

[47] The U.S. Army AMRDEC (the Aviation and Missile Research Development and Engineering Center) is a subordinate command of the Research Development and Engineering Command which is a Major Subordinate Command under the Army Materiel Command. The author is a member of the AMRDEC.

[48] United States Army Aviation Warfighting Center, "Aviation Modernization Roadmap", briefing slides with scripted commentary, United States Army Aviation Warfighting Center, 31 January 2008.

[49] Ibid. Near term - FY 2008-2009, POM years - FY 2010-2015, Extended Planning Period - FY 2016-2024.

[50] U.S. Department of Defense, Director of Defense Research and Engineering, 2007 Department of Defense Research and Engineering Strategic Plan, (Washington, D.C.: U.S. Department of Defense, 2007), 4.

[51] Ibid., 7.

[52] Ibid., 8.

[53] The questionnaire was sent to Bell Helicopter, Boeing, Sikorsky, AgustaWestland, Eurocopter, the American Helicopter Society, the Army Aviation Association of America, Rotor and Wing Magazine, the Huntsville Research Laboratory of the Georgia Tech Research Institute, the Institute for Advanced Technology at the U.S. Army Research Laboratory, and the Association of the United States Army.

The questionnaire was slightly different for each type of entity. The questionnaire to the U.S. companies contained the following:

Rotorcraft is defined as an air vehicle that utilizes a rotating airfoil for its primary means for vertical lift.

1. On average, what percentage of your company's budget is for the research and development (R&D) of technology used for/on rotorcraft?

Has this funding increased or decreased in the past five years?

Do you anticipate an increase or decrease in this funding in the next five years?

2. How much of the rotorcraft research and development funding is from contracts with Governments versus "internal" funding? (Internal funding meaning funding derived from profits or other non contract resources, e.g. sales of stock.)

Has this funding increased or decreased in the past five years?

Do you anticipate an increase or decrease in this funding in the next five years?

How much of the funding is and/or will be from contracts with foreign Governments versus the U.S. Government?

3. In your opinion, do you believe that there has been a decline in U.S. Government funding for research and development of rotorcraft technology?

How about from foreign Governments?

If so what do you think caused that decline?

If not, what causes you the note no decline in investment?
Do you have any documentation that supports your opinion? (Please provide me a copy if possible.)

4. A literature search resulted in no specific document/report identified as the Army vision for aviation. Do you know of any documentation or report that reflects the vision for Army aviation?

If so what is the name of that document/report and can you provide me a copy?

5. Do you have any additional comments?

[54] No names are being used as the letter or email that accompanied the survey sent to the companies and professional organizations stated that any data collected would be discussed from the perspective of the industry and not individual entities.

[55] J. Gordon Leishman, Rotorcraft Aeromechanics-Getting Through the Dip, American Helicopter Society, (23-25 January 2008), 4.

[56] Ibid., 9.

[57] Aerospace Industries Association, Securing the Future of America's Rotorcraft Industry, A report of the Rotary Wing Revitalization Project, (Arlington, VA: Aerospace Industries Association of America, Inc., 2007) 6.

[58] Ibid., 8.

[59] Ibid., 6.

[60] Ibid., 1.

[61] "An Art at Risk," Rotor and Wing, 42, No. 4, April 2008, 40.

[62] Aerospace Industries Association, U.S. Defense Modernization: Readiness Now and for the Future, (Arlington, VA: Aerospace Industries Association, April 2008) 4.

[63] U.S. Department of Defense, Office of the Under Secretary of Defense (Industrial Policy), The Vertical Lift Industrial Base: Outlook 2004-2014, (Washington, DC: U.S. Department of Defense, July 2004), 18.

[64] Congressional Representative Joe Sestak and Kay Granger, letter to Secretary of Defense Robert Gates and Joint Chiefs of Staff Chairman Admiral Michael Mullen (U.S. Navy), Washington, DC, 18 January 2008.

[65] Ibid.

[66] Brigadier General Stephen D. Mundt is the Director for Army Aviation in the Office of the Deputy Chief of Staff, G3/5/7, U.S. Army.

[67] House Committee on Armed Service, Statement by Brigadier General Stephen D. Mundt is the Director for Army Aviation in the Office of the Deputy Chief of Staff, G3/5/7, U.S. Army, (Washington, DC: U.S. Congress, 22 March 2007), 14.

[68] In trying to track down a copy of the Army Aviation S&T Program and the Aviation Modernization Strategy as referenced by BG Mundt, the author has concluded that these are basically the Army Science and Technology Master Plan and the Army Aviation Modernization Plan presentation chart as previously discussed.

[69] Malcolm Gladwell, Blink, (Boston, MA: Little, Brown and Company, 2000), 256.

[70] Ibid.

[71] There was limited data in the FY 1998 to 2000 timeframe. From the S&T and RDTE perspective, investment data older than five years is not representative to today's issues and requirements. Also argued here is that several foreign Governments subsidize companies. Most notably is the French Government's ownership in EADS, the United Kingdom's ownership in British Petroleum, and Germany's ownership in DaimlerChrysler. One reference is available from <http://www.guardian.co.uk/business/2006/jun/22/1>; Internet; accessed 28 April 2008.

[72] GEN William Wallace, TRADOC Commander, "TRADOC Commander's Perspective", briefing slides with scripted commentary, U.S. Army War College, 1 February 2008. Actual briefing to Resident Program canceled due to weather.